PATENT SPECIFICATION

DRAWINGS ATTACHED

933,825

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Date of filing Complete Specification April 25, 1961.

Application Date Feb. 1, 1960. *No. 3502/60.*

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Index at acceptance:—Class 82, A1, A8(A2:K:M:R:T).

International Classification:—B23n, C22c.

COMPLETE SPECIFICATION

Improvements in or relating to Sintered Metal Filters

object of the present invention is to provide a construction which ensures comparatively fine filtration and high permeability.

According to one aspect of this invention a sintered metal filter of the kind referred to comprises an assemblage of outer layers formed from wire mesh or perforated sheet metal or expanded metal sheet having a required pore size and a filling of one or more layers of metal powder between the outer layers which assemblage is sintered throughout.

According to another aspect of this invention a sintered metal filter of the kind referred to comprises an assemblage of an outer layer or layers formed from wire mesh or perforated sheet metal or expanded metal sheet having a required pore size and a filling of a different character to that of said outer layer or layers and comprising one or more layers of felted metal fibres which assemblage is sintered throughout.

The wire mesh may have the individual wires spread by flattening under pressure to an extent to provide the required porosity.

A method of forming a filter of the character set out above consists in compacting the filling prior to its assemblage between the outer layers and whereafter the assemblage of layers is sintered under pressure.

Alternatively the filling may be assembled biscuit of metal powder preformed by a pressing operation whereafter the other outer layer is applied to the metal powder and sintering is effected, preferably under pressure.

In the case where each outer layer comprises wire mesh it may be subjected to a pressing operation to spread the wires before assemblage with the metal powder or metal fibres.

The sintering of the various layers may be carried out simultaneously in the one operation; alternatively the layer which is to be disposed between the outer layers may be subjected to a preliminary sintering operation, the outer layers being subsequently bonded to it by a separate sintering operation.

The metal employed for the outer layers may be different from that of the intermediate layer or layers; for example, the metal employed for the mesh may be steel, "MONEL" (Registered Trade Mark), bronze, copper, stainless steel, nickel or nickel base alloys and silver as set out in Application No. 21908/58 (Serial No. 926,911).

The wire mesh may be single or multiple mesh.

The mesh type, weave or size may be different on opposite sides of the sandwich.

The size of the wires in a wire mesh sheet

ERRATA

SPECIFICATION NO. 933,825

Page 1, in the heading, *for* "DRAWINGS ATTACHED" *read* "NO DRAWINGS"

THE PATENT OFFICE,
22nd November, 1963

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COMPLETE SPECIFICATION

Improvements in or relating to Sintered Metal Filters

We, SINTERED PRODUCTS LIMITED, a British Company, of Sheepbridge Works, Chesterfield, Derbyshire, and LESLIE HARRISON, a British Subject, of the Company's address, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to sintered metal filters of the kind in which metal powder and wire mesh or perforated sheeting are sintered together. One form of such filter is described in Specification No. 665,292. An object of the present invention is to provide a construction which ensures comparatively fine filtration and high permeability.

According to one aspect of this invention a sintered metal filter of the kind referred to comprises an assemblage of outer layers formed from wire mesh or perforated sheet metal or expanded metal sheet having a required pore size and a filling of one or more layers of metal powder between the outer layers which assemblage is sintered throughout.

According to another aspect of this invention a sintered metal filter of the kind referred to comprises an assemblage of an outer layer or layers formed from wire mesh or perforated sheet metal or expanded metal sheet having a required pore size and a filling of a different character to that of said outer layer or layers and comprising one or more layers of felted metal fibres which assemblage is sintered throughout.

The wire mesh may have the individual wires spread by flattening under pressure to an extent to provide the required porosity.

A method of forming a filter of the character set out above consists in compacting the filling prior to its assemblage between the outer layers and whereafter the assemblage of layers is sintered under pressure.

Alternatively the filling may be assembled in a loose state between the outer layers and the resulting sandwich is then compacted and sintered.

In an alternative method, short staple metal fibres are deposited from a slurry on to one of the outer layers whereafter the other outer layer is placed on top of the layer of fibres and the assemblage is then sintered preferably under pressure.

In yet another method, metal powder is disposed on one of the outer layers either by deposition on it of the metal powder from a slurry or by strickling a layer of metal powder on to the layer or by placing upon it a biscuit of metal powder preformed by a pressing operation whereafter the other outer layer is applied to the metal powder and sintering is effected, preferably under pressure.

In the case where each outer layer comprises wire mesh it may be subjected to a pressing operation to spread the wires before assemblage with the metal powder or metal fibres.

The sintering of the various layers may be carried out simultaneously in the one operation; alternatively the layer which is to be disposed between the outer layers may be subjected to a preliminary sintering operation, the outer layers being subsequently bonded to it by a separate sintering operation.

The metal employed for the outer layers may be different from that of the intermediate layer or layers; for example, the metal employed for the mesh may be steel, "MONEL" (Registered Trade Mark), bronze, copper, stainless steel, nickel or nickel base alloys and silver as set out in Application No. 21908/58 (Serial No. 926,911).

The wire mesh may be single or multiple mesh.

The mesh type, weave or size may be different on opposite sides of the sandwich.

The size of the wires in a wire mesh sheet

may also be as set out in Application No. 21908/58 (Serial No. 926,911), for example between 0.004 inches and 0.015 inches in diameter, and the dimensions of the openings in the perforated sheet, for example from 0.030 inches to 0.100 inches in diameter, or expanded metal sheet, for example from 0.030 inches to 0.150 inches in width, and the sintering temperatures, for example between 800° C. and 900° C. for bronze or 1340° C. and 1380° C. for steel, and the mode of preparing the sheets before sintering may also be as set out in that application.

The felted metal fibres may be compacted and sintered by forming one or more layers of metal fibres, compacting the layer or layers either by a rolling operation or pressing operation with or without the application of a lubricant, sintering the compacted fibres with or without the application of pressure at a temperature to bond their contacting surfaces or to bond a metal coating (when such is used) with or without a further rolling or pressing operation, with or without a final sintering operation. The coating may be a metal of lower melting temperature than the melting temperature of the fibres.

Alternatively pressing or rolling may be carried out after sintering and then re-sintering or annealing effected.

The following is an example of a sandwich from powdered metal.

EXAMPLE I

Ni/Cr stainless steel powder of −100 mesh particle size (British Standard Sieve) is pressed in a rectangular die under pressure of 10 tons per square inch to give a green compact measuring 2-1/2 inches long by 1-1/4 inches wide by 3/16 of an inch thick. To facilitate pressing 1% of stearic acid was added to the powder before pressing. The green compact, which is very fragile, is next dewaxed by heating to 400° C. in a protective atmosphere and is then sintered for 30 minutes at 1290° C., also in protective atmosphere.

The sintered piece is then placed between two layers of stainless steel mesh after first flattening the mesh by passing it between rolls applying light pressure. The whole assembly is then sintered for 30 minutes at 1320° C. in an atmosphere of cracked ammonia.

As indicated above, one or more layers of powder may be used.

The following is an example of forming a sandwich from powdered metal where a loose powder is used.

EXAMPLE II

An "ARMCO" (Registered Trade Mark) iron tray measuring 3-1/2 inches long by 1-1/2 inches wide with 1/4 inch deep walls, is coated on the interior with an alumina wash to prevent sticking and a piece of stainless steel gauze cut to size is placed in the bottom of the mould. Stainless steel powder (18/10 Cr/Ni) −100 mesh particle size is filled into the tray on top of the gauze and the excess removed by drawing a straight-edged strickle along the powder surface. The mould is gently tapped to settle the powder slightly and a second piece of gauze placed on top. This is held in position by a 3/8 of an inch thick mild steel plate resting on the upper layer of mesh and the whole assembly is heated for 30 minutes at 1320° C. in protective atmosphere, after which the "sandwich" is knocked out of the boat and then trimmed.

The following is an example where staple felted metal fibres are used.

EXAMPLE III

Commercial stainless steel wool is first milled to give an average fibre length of 3/16 of an inch and mixed to a slurry in an edge runner mill with glycerine. The slurry is poured into a shallow frame, the bottom of which is formed by a piece of stainless steel mesh which has been rolled to flatten it and reduce the pore size sufficiently to prevent the passage of fibre particles. The frame holding the mesh is connected to a vacuum pump and most of the glycerine is removed by suction through the mesh. The remainder is washed out by a solvent (still in the same vacuum rig) and after this the mesh, with its layer of deposited fibre, is dried before placing in a sintering tray. A second layer of mesh is placed on top of the fibre layer and a weight applied as in Example II and the whole sintered by heating for 30 minutes at 1360° C.

The consistency of the slurry must be very fluid to enable it to be drawn off freely; and when it is mixed it is very like a thin cream.

As indicated above, the second layer of mesh may be omitted and one or more layers of fibres may be used.

This general process is also applicable to a slurry of metal powder and glycerine.

The second layer of mesh which is placed on top of the fibre layer or on top of the powder may be of different weave, to the layer beneath the fibre or powder, for example the spaces between adjacent wefts and between adjacent warps may be 0.005 inches in one case of mesh whilst in the second layer such a space may be of the order of 0.075 inches. One mesh may contain a square hole whilst the second layer could be of a diamond shape.

The fibre layer can also be made by depositing it from a slurry on to a travelling belt and sintering it as a continuous mat. In this case, after sintering or pre-sintering sufficiently to enable it to be handled the fibre mat would be cut to size, placed between mesh and the pieces sintered as before.

The methods set out above do not need rolling after the first sintering. Further compacting and sintering cycles may be applied to reduce the pore size of the filter or increase its strength.

Some of the samples made in which the middle layer has been made from sintered stainless steel powder and the outer layers of stainless steel gauze, have been reduced in thickness by rolling after sintering. A reduction of the order of 10% has been achieved. This has had the effect of further compacting the middle layer and reducing the flow rate of a fluid through the filter whilst, at the same time, enabling it to retain small diameter particles. Rolling has little effect on the pore size of the outer gauze layers, most of the deformation taking place in the central powder or fibre layer. Annealing afterwards is desirable if any subsequent forming is to be done on the material during the fabrication into a filter since the annealing has the effect of improving the ductility of the filter after rolling.

Alternatively pressing or rolling may be carried out after sintering and then re-sintering or annealing effected.

It is found that whilst sintered mesh filters as described in Application No. 21908/58 (Serial No. 926,911), have a wide field of application their permeability is somewhat low when used for a very fine filtration as compared with normal sintered metal powder filters.

The sandwich type of construction according to the present invention combines the best of the two types of filter medium since it possesses in its centre layer a porosity similar to that found in sintered powdered filters and therefore acts as a filter "in depth". This characteristic results in fine filtration coupled with relatively high permeability. The presence of the mesh or perforated sheet metal or expanded sheet metal in the two outer layers gives the filter a strength comparable to that of the filter described in Application No. 21908/58 and distributes the fluid flowing through the filter and acts as a primary filtration stage. The outer layers also serve to prevent the possible escape of particles of fibres or powder making up the centre layer of the filter should there be a tendency for small sections to disintegrate.

WHAT WE CLAIM IS:—

1. A sintered metal filter of the kind referred to and comprising an assemblage of outer layers formed from wire mesh or perforated metal or expanded metal sheet having a required pore size and a filling of one or more layers of metal powder between the outer layers which assemblage is sintered throughout.

2. A sintered metal filter of the kind referred to and comprising an assemblage of an outer layer or layers formed from wire mesh or perforated sheet metal or expanded metal sheet having a required pore size and a filling of a different character to that of said outer layer or layers and comprising one or more layers of felted metal fibres which assemblage is sintered throughout.

3. A sintered metal filter according to Claim 1 or Claim 2 wherein the wire mesh has the individual wires spread by flattening under pressure to an extent to provide the required porosity.

4. A method of forming a filter according to Claim 1 or Claim 2 or Claim 3 which consists in compacting the filling prior to its assemblage between the outer layers and whereafter the assemblage of layers is sintered under pressure.

5. A method of forming a filter according to Claim 1 or Claim 2 or Claim 3 in which the filling is assembled in a loose state between the outer layers and the resulting sandwich is then compacted and sintered.

6. A method of forming a filter according to Claim 2 or Claim 3, in which short staple metal fibres are deposited from a slurry on to one of the outer layers whereafter the other outer layer is placed on top of the layer of fibres and the assemblage is then sintered preferably under pressure.

7. A method of forming a filter according to Claim 1 in which metal powder is disposed on one of the outer layers either by deposition on it of the metal powder from a slurry or by strickling a layer of metal powder on to the layer or by placing upon it a biscuit of metal powder preformed by a pressing operation whereafter the other outer layer is applied to the metal powder and sintering is effected, preferably under pressure.

8. A method of forming a filter according to any of Claims 4 to 7 and in which each outer layer comprises wire mesh and in which said wire mesh is subjected to a pressing operation to spread the wires before assemblage with the metal powder or metal fibres.

9. A method of forming a filter according to any of Claims 4 to 8 in which the sintering of the various layers is carried out simultaneously in the one operation.

10. A method of forming a filter according to any of Claims 4 to 8 in which the filling which is to be disposed between the outer layers is subjected to a preliminary sintering operation and the outer layers are subsequently bonded to it by a separate sintering operation.

11. A sintered metal filter according to Claim 1 or Claim 2 or Claim 3 in which the mesh type, weave or size is different on opposite sides of the sandwich.

12. A method of forming a filter according to any of Claims 4 to 10 and in which the outer layers are wire mesh in which the mesh type, weave or size is different on opposite sides of the sandwich.

13. A method of forming a filter according to any of Claims 4 to 10 in which

pressing or rolling is carried out after sintering and then re-sintering or annealing is effected.

14. A sintered metal filter according to Claim 1 or Claim 2 and substantially as described.

15. A method of forming a filter according to Claim 1 or Claim 2 and substantially as described.

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